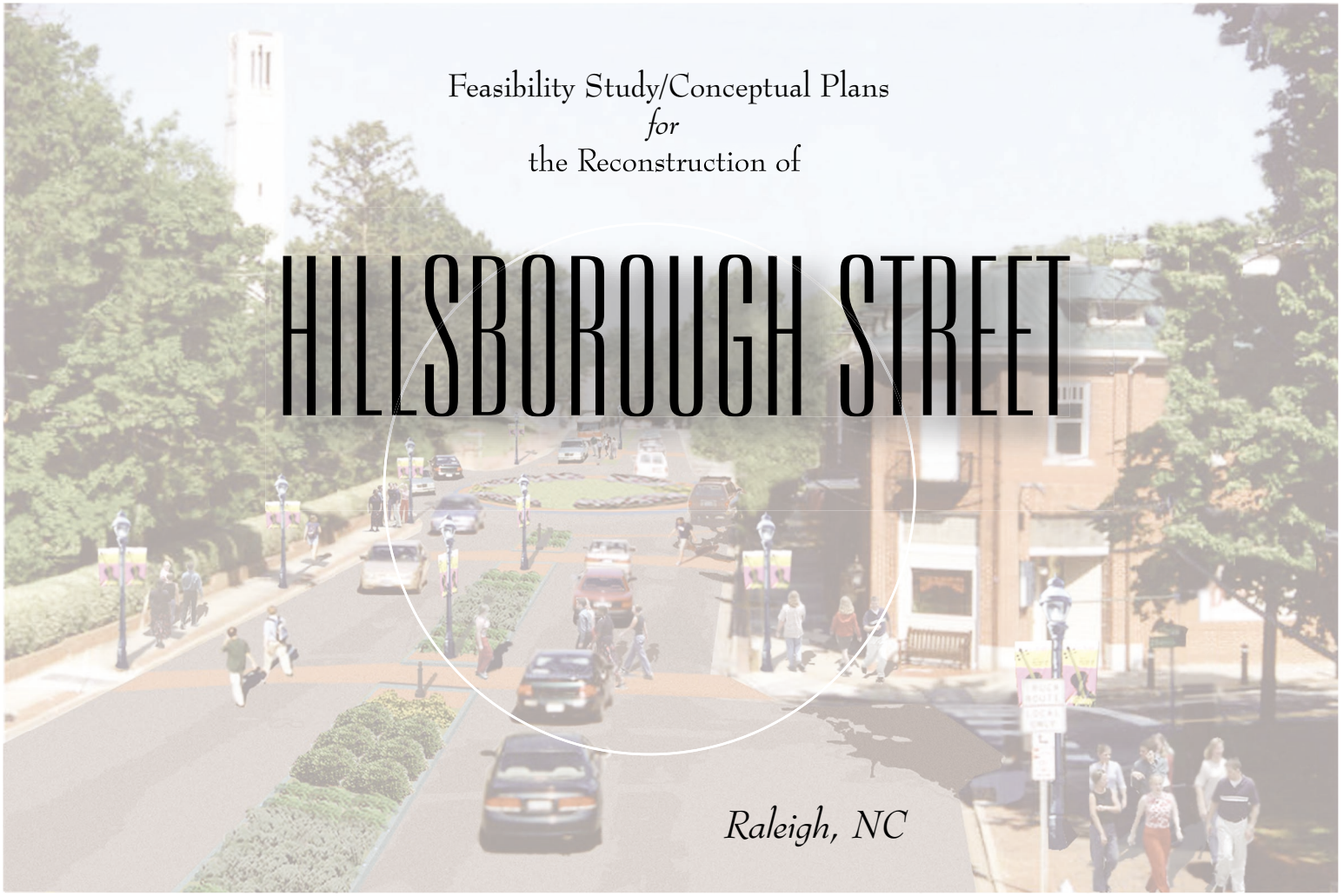
Final Report



Feasibility Study/Conceptual Plans
for
the Reconstruction of

HILLSBOROUGH STREET

Raleigh, NC

THE Hillsborough Street PARTNERSHIP

Kimley-Horn and Associates, Inc.

with Michael Wallwork of Alternate Street Design

December 2001

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ACKNOWLEDGEMENTS

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QUOTES

Never underestimate the power of a small group of dedicated people to change the world. Indeed it is the only thing that ever has.

- Margaret Mead

"Progress occurs when people cooperate."

- Hal Burton

"isn't it grand that plans are visionary! Why shouldn't a community have a view, a vision of what it wants to be, and then try to achieve it?"

- Allan Jacobs

EXECUTIVE SUMMARY

Conceived by the public, nurtured by a diverse group of partners, and studied by scientists and engineers, the innovative program for improving Hillsborough Street has achieved an important milestone in the Summer of 2001 — approval by the Raleigh City Council. Further testament to the political support these program has is the decision this Summer to jointly fund the first project — a roundabout on Pullen Road at Stinson Drive. The entire program includes seven distinct construction projects that will result in eleven roundabouts and two miles of reconstructed street and streetscape. The consensus objective is to enhance pedestrian and motorist safety and facilitate the "destination" aspect of businesses rather than catering to the passer-by. The finished product will be a whole new look for Hillsborough Street — a destination rather than a through street.

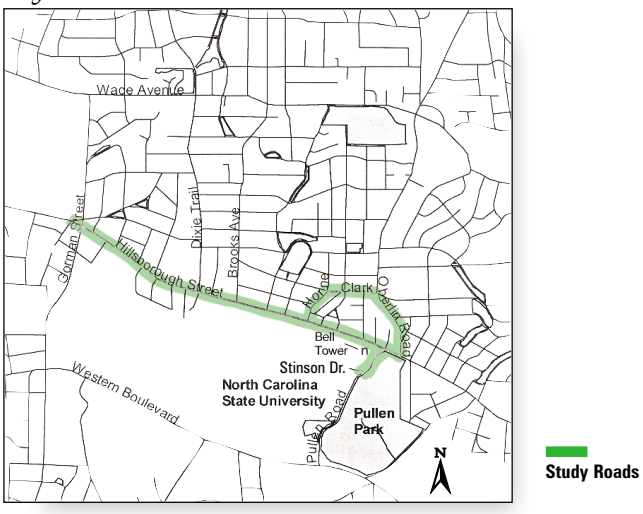
The program includes the following actions:

- Eliminate traffic signals at 7 intersections/replace with modern roundabouts
- Remove stop signs at 4 intersections/replace with modern roundabouts
- Eliminate traffic signals at 3 intersections/build median to preclude left-turns
- Eliminate the closely-spaced intersections near the Bell Tower
- Maintain 2 signalized crossings for pedestrians with low vision and wheelchairs
- Eliminate left-turns at 20 intersections and 30 driveways/replace with right-turn only
- Provide one through lane in each direction on Hillsborough Street, with additional approach lanes at intersections with Pullen Road and also at Gorman Street
- Build 7-foor wide raised-curb median along Hillsborough Street and Clark Avenue
- Widen sidewalks and crosswalks throughout the corridor
- Build highly-visible crosswalks at an average of 300-foot intervals near the NC State Campus
- Plant more street trees
- Install pedestrian-scale streetscape features including sidewalk and crosswalk pavement detailing, granite curbs, plants, period lamps, benches, kiosks, bus shelters, planters, street directories, and wayfinding signs
- Increase the number of on-street parking spaces on Hillsborough Street
- Modify parking enforcement policies to be more customer-friendly
- Widen the south side of Hillsborough Street between Dan Allen Drive and Horne Street to improve bus service
- Connect alleys behind several blocks of retail stores

Study Area

The focus of this study is the feasibility of transportation-based improvements in the street sections shown in Figure 1 and listed below.

Figure 1



Hillsborough Street between Gorman Street and Oberlin Road *(about 1.5 miles)*
Pullen Road between Stinson Drive and Hillsborough Street *(about 1/8 mile)*
Oberlin Road between Hillsborough Street and Clark Avenue *(about ¼ mile)*
Clark Avenue between Oberlin Road and Horne Street *(about 1/8 mile)*
Horne Street between Clark Avenue and Hillsborough Street *(about 1/8 mile)*

Supporting programs are recommended to relocate and bury utility lines, build a parking deck at the corner of Hillsborough Street and Logan Court, and install modern electronics to aid pedestrians crossing Hillsborough Street.

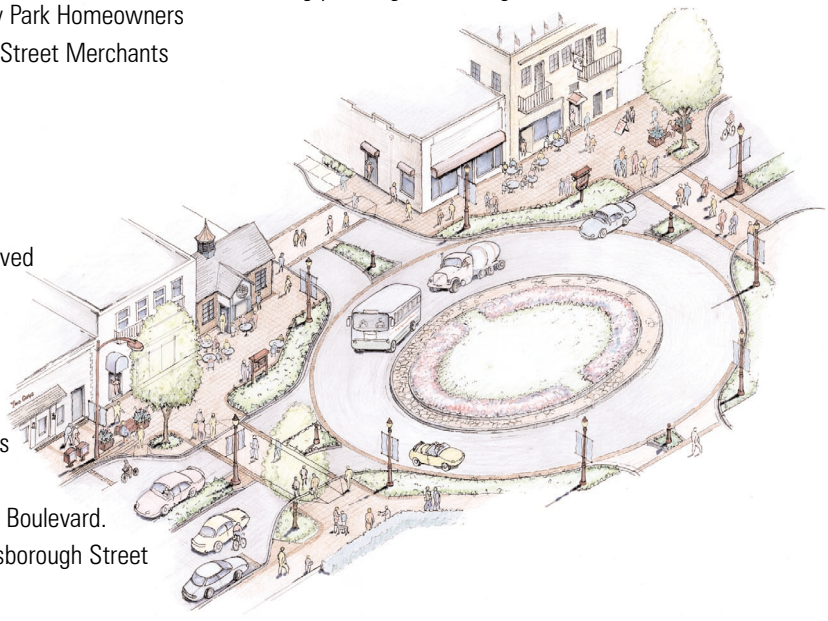
The $16 million program (excluding utility relocation) will be built in stages according to a sequence that targets the most difficult traffic problems first. A roundabout at the intersection of Pullen Road and Stinson Drive will smooth traffic flow, minimize the effect of limited sight distance, and enhance pedestrian safety at this gateway to NC State's North Campus. The Raleigh City Council adopted a new Pullen Park Master Plan that includes a secondary entrance connecting with the roundabout at Pullen and Stinson. Construction is anticipated in 2002. Funding for the first project is promised by the Raleigh City Council and NC State University Board of Trustees in equal shares.

Funding agreements for future projects will be determined by partnering agencies as project planning and stakeholder involvement meetings continue. Implementation of the program will be nurtured by the Hillsborough Street Partnership, a new non-profit group comprised of the University Park Homeowners Association and the Hillsborough Street Merchants Association.

Study Results

Gradual construction of the approved program will result in incremental changes to travel patterns. Once the full program in completed, up to 30 percent of existing traffic using Hillsborough Street as a through route will likely use alternate routes such as Western Boulevard. Growth in business along the Hillsborough Street corridor will add some traffic. Resulting traffic conditions are expected to carry about 30,000 vehicles per day traveling at 15 to 20 mph throughout the corridor. Existing average travel speeds range from 20 to 25 mph with typically two full stops at red lights, behind a stopped bus, or behind a vehicle waiting to turn left. With the program of improvements, reasonable travel speeds will be achieved which will produce significant reductions in traffic crashes. The safety improvements have an annualized benefit of at least $500,000. The safety benefits are derived primarily from the design changes that will slow traffic and the elimination of left-turn movements at all intersections in the corridor.

An eight-member Steering Committee representing business, university, residential, and governmental organizations met frequently to develop the recommended program and refine concept plan drawings that are presented in Section 5 of this report. Further refinements of the program are anticipated as each construction project is presented to neighboring residents, business and property owners, and interested citizens. For more information, log onto the City's project website at www.raleigh-nc.org/planning/hillsborough/home.



INTRODUCTION

Background

Hillsborough Street evokes wonderful memories and promises for a bright future.

Hillsborough Street is one of the most important corridors in Raleigh. It links the State Capitol to the State Fairgrounds, connecting the heart of the city to one of our state's greatest institutions, NC State University. Bordering a retail district and historic neighborhoods on one side of the street and the University on the other side, the diverse and densely populated area has the potential to be a prime destination.

The Hillsborough Street Partnership was created to help this historic corridor live up to its potential. It is a partnership of the City of Raleigh, North Carolina Department of Transportation, NC State University, Hillsborough Street Merchants Association, and the University Park Homeowners Association.

Timeline of Important Events

October 1999 – over 500 community members participated in the Hillsborough Street charrette, led by nationally renowned planners and engineers Dan Burden, Michael Wallwork, and Ramon Trias. A "New Vision of Hillsborough Street" was crafted.

April 2000 — the Hillsborough Street Partnership led by Honorary Chair and former Mayor Smedes York went before the Raleigh City Council and asked that improvements to Hillsborough Street be funded partially through road bonds. The council reacted favorably as did voters by passing a referendum in support of a bond package with $3 million for pedestrian-oriented improvements on Hillsborough Street.

December 2000 – consultant hired to prepare a feasibility study of visionary improvements along Hillsborough Street between Oberlin Road and Gorman Street, including segments of Pullen Road, Oberlin Road, Clark Avenue, and Horne Street. An eight-member Steering Committee guided the development of the feasibility study.

March 2001 - Project website launched. Visit *www.raleigh-nc.org/planning/hillsborough/home*

April 2001 – an interim progress report and presentation to the Raleigh City Council by the Hillsborough Street Steering Committee and consultant recommends the design and construction of a roundabout and associated improvements at the intersection of Pullen Road and Stinson Drive along with further study of the remainder of the corridor.

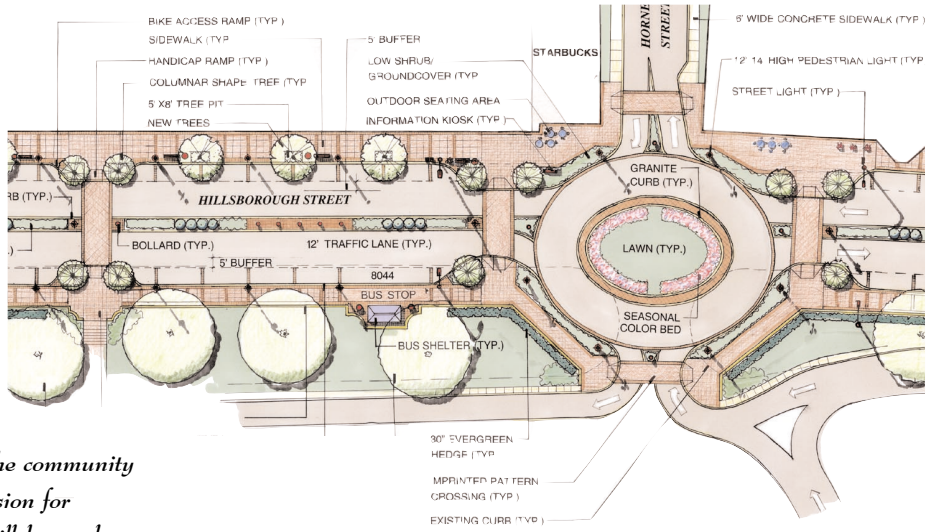
Earth Day, 2001 – The Environmental Ethics class at NC State University hosted a street fair on Hillsborough Street to commemorate Earth Day, including the creation of a wall mural on the east façade of Kinko's in the 2300 block of Hillsborough Street. Later, the NC State Schools of Design and Engineering presented results of a semester-long collaborative study of the Hillsborough Street area.

May 2001 – Application filed to create a non-profit corporation, the Hillsborough Street Partnership.

May 2001 – Raleigh City Council and NC State University Board of Trustees agree to jointly fund the design and construction of a roundabout at Pullen Road and Stinson Drive. The project will address traffic congestion and safety concerns at this intersection near the Bell Tower.

May 2001 - Raleigh Parks and Recreation Board adopted revisions to the Pullen Park Master Plan that includes a major new entrance to the Park at the proposed Pullen Road / Stinson Drive roundabout.

July 2001 - Raleigh City Council accept the Feasibility Study with additional changes targeting immediate parking improvements.



The community vision for Hillsborough Street includes two lanes of traffic, a median to block left turns, pedestrian crossings, more on-street parking, and roundbouts.

Community Vision

The plan was developed through an intense community visioning process held in October 1999 and advertised as "Creating a New Vision for Hillsborough Street Workshops". Over 500 people from throughout the community participated in the workshops. The plan was developed by a team of experts that included volunteer planning and design professionals, paid consultants, and staff from the Raleigh Planning and Transportation Departments, the North Carolina Department of Transportation, and NC State University. The plan is to put Hillsborough Street on a "road diet", as described below:

- Convert a four-lane "through" road with stop-and-go traffic to a two-lane street moving vehicles, pedestrians, bicyclists, and buses more safely and efficiently.
- Enhance the area as a "destination", a place to leave your vehicle and spend time studying, socializing, strolling and shopping.
- Pedestrian scale improvements at crosswalks and sidewalks. A narrowing of the number of travel lanes to one in each direction will enhance pedestrian safety.
- Keep traffic flowing at reasonable speeds of 20 to 25 mph. Traffic signals will be replaced with roundabouts at seven intersections along Hillsborough Street. Roundabouts are recommended at four other intersections in the study area. Left-turning vehicles will be accommodated around the roundabouts.
- A median will be constructed to preclude mid-block left-turns and enhance pedestrian safety.
- An increase in the number of parking spaces is planned along both sides of Hillsborough Street.
- With the introduction of a five-foot wide buffer area between the travel lane and on-street parking spaces, safety will be enhanced for bicyclists, drivers and passengers opening doors from parked vehicles, and motorists beginning a parallel parking maneuver. The buffer area will also provide needed space for motorists to pull to the right when emergency vehicles need to pass.

2.0 EXISTING CONDITIONS

Hillsborough Street has a variety of functions. It serves an important traffic function, as well as a key pedestrian way, transit corridor, and a lively business center. Each of these is described below.

Traffic — Hillsborough Street, owned and maintained by the State of North Carolina, is located within the City of Raleigh. It is designated as a major thoroughfare on the Wake County Thoroughfare Map. The pavement width varies from 36 feet in the section between Dixie Trail and Furches Street to 50 feet elsewhere in the study area. The posted speed limit is 35 mph, however, prevailing speeds often exceed this as motorists rush to make a green light or avoid a bus stopped to pick up and discharge passengers. There are 13 signalized intersections on Hillsborough Street between (and including) signals at Gorman Street and Oberlin Road. Traffic counts conducted in November 2000 while school was in session resulted in a daily traffic volume of 26,000 vehicles per day on Hillsborough Street just west of Horne Street.

Pedestrian — counts of pedestrians crossing Hillsborough Street conducted in November 2000 tallied peak 30-minute observations of over 400 pedestrians crossing at Horne Street, 200 pedestrians crossing at Gardner Street, and over 100 pedestrians crossing at Dan Allen Drive. The peak time for pedestrians is typically during lunch and during class interval times.

Transit — Hillsborough Street is a busy transit corridor, serving multiple overlapping bus routes for three different transit systems: operated by NC State University, the City of Raleigh and the Triangle Transit Authority. It is estimated that over 10,000 people patronize one or more bus systems on a typical school day.

Bicycle — Efforts are underway to improve a linkage for bicyclists through the study area to connect downtown Raleigh with a planned greenway crossing through Meredith College, over the I-440 freeway to the State Museum of Art. Currently, the signed bicycle route through the study area follows less crowded streets including Clark Avenue, Everett Avenue, Park Drive, and Hawthorne Drive. Counts conducted in November 2000 tallied, at most, five bicyclists on Clark Avenue (at Horne Street) and seventeen on Hillsborough Street (at Horne Street) during the peak hour.

Trucks — on the steep hill between Daisy Street and Furches Street, Hillsborough Street carries as many as 14 heavy trucks (defined as trucks with three or more axles) during the peak hour. There is concern for the traffic congestion these trucks would create if Hillsborough Street is narrowed to one lane in each direction, particularly traveling uphill. Truck generating businesses in the area such as NC Equipment Company, Servitex and Carolina Power & Light are expected to continue generating truck traffic.

Utilities — an inventory of aerial utility lines shows multiple private utility companies operating in the corridor with lines along both sides of, and crossing, Hillsborough Street. The criss-crossing web of utility lines detract from the aesthetic improvement desired for the corridor and the utility poles are a safety concern for motorists, pedestrians, bicyclists and bus patrons. Block-by-block improvement strategies are recommended, ranging from underground burial to aerial relocation and consolidation. These recommendations are discussed in Section 4.0.

A jungle of utility wires create an ugly view.

Circulation and parking behind Hillsborough Street businesses can be improved to serve parking, deliveries, and relocated utilities.

Alleys — Short sections of narrow, bumpy pavement currently serve as dead-end parking lots behind some of the Hillsborough Street businesses. While an "alley" in the true sense of the word denotes a continuous travelway on the back side of a row of buildings, what exists today does not continue from one block to another and is not wide enough to allow cars to pass a delivery truck.

Business Activity — during the mid-day while school is in session, business is brisk at restaurants and shops between Gorman Street and Oberlin Road. Activity slows down on most evenings and weekends as students travel elsewhere and residents of adjacent neighborhoods seek trendier addresses such as South Glenwood Avenue and Downtown Raleigh.

However, it is from May into August each year that business revenue drops precipitously along Hillsborough Street. Several recent business failures reinforce the tenuous situation. Turning this dangerous business cycle around is a key goal of the improvement plan.

Fast moving traffic and non-supportive parking enforcement procedures are among the factors in the demise. Factors outside the scope of this study that affect business conditions on Hillsborough Street include store rent structure and competition from businesses in other parts of Raleigh. On the bright side, businesses on Hillsborough Street sit across the street from a huge market – NC State University.

A revitalized Hillsborough Street will bring customers year long, even during the slow summer break.

3.0 STUDY GOALS & METHODOLOGY

Study goals established in the 1999 charrette and carried forward through the feasibility study are listed below, in no particular order:

- Create a plan for the public street and sidewalk portion of the study corridor. Develop a gradual implementation strategy and work through the Partnership to identify and secure public and private funding for the plan.
- Enhance the year-round "destination" characteristic of the study area by:
  - adding new storefront social gathering spaces
  - creating attractive gateways and vistas
  - clarifying the search for available parking
  - introducing unifying design elements that continue from one end of Hillsborough Street to the other end.
- Reduce the frequency and severity of crashes In particular, reduce the number and severity of injuries experienced by pedestrians by simplifying street crossings and reducing vehicle speeds.

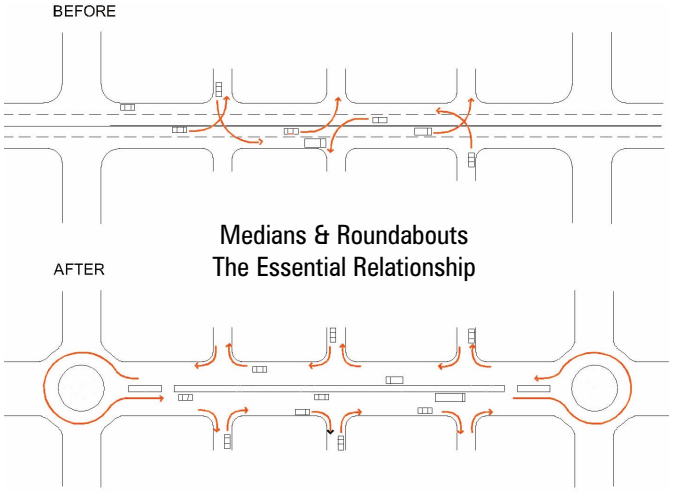
Feasibility Study

Feasibility of the planned improvements is evaluated based on traffic operations, areawide traffic diversions, travel safety, and cost. A traffic operations analysis conducted for this study compares base year 2000 conditions with and without the planned improvements. Areawide traffic impacts are analyzed in this study based on year 2000 and 2025 traffic projections to consider possible traffic diversions once the Hillsborough Street traffic has been calmed. Safety is considered in terms of historical crash data as well as estimates of anticipated reductions in the frequency and severity of crashes.

The conclusion of this study is that the planned improvements for Hillsborough Street are feasible in terms of traffic and will result in significant benefits in terms of reducing the frequency and severity of crashes, particularly those involving injuries. The total cost is estimated at $ 11 million (year 2001 dollar values).

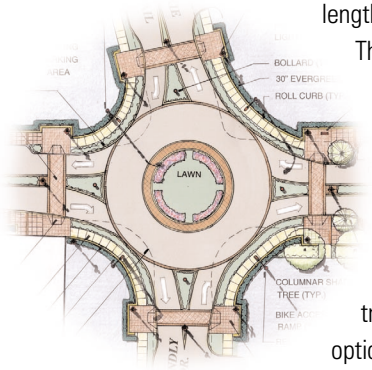
Planned Improvements

To maintain efficient vehicle flow with fewer lanes, roundabouts were proposed at numerous intersections along the Hillsborough Street corridor and at nearby intersections serving the corridor.



A roundabout reduces the number of conflict points between vehicles and also between pedestrians and vehicles. The basic operation of a modern roundabout is to give the right-of-way to vehicles that are in the circulating roadway. Approaching vehicles must yield before turning right to proceed into the circulating roadway, and all exiting turns are right-turn movements. Roundabouts eliminate dangerous left-turning vehicular movements and reduce conflicts, thereby increasing the safety over a conventional intersection. Through careful design of the intersection geometry, vehicle speeds are greatly

reduced when roundabouts replace traffic signals at intersections.



Pedestrians cross roundabouts on the approaches, with well-marked crosswalks located one vehicle-length away from the circulating roadway. This design treatment allows for the lead vehicle to watch for gaps in traffic circulating in the roundabout while pedestrians cross behind the lead vehicle. Refuge areas are created in the splitter island to reduce the amount of time pedestrians are in the travel lanes during crossing. A design option that provides positive guidance for pedestrians with low vision is to install or maintain audible signalized pedestrian crossings. These must be placed outside of the influence of the roundabout to avoid traffic queues.

Buses and trucks are considered in the overall corridor design and within the design of individual roundabouts. Transit service and truck deliveries will be maintained throughout the corridor. A median is planned along Hillsborough Street to restrict turning movements and reduce the number of vehicular conflicts. The median will also contribute to the aesthetic quality of the streetscape through a combination of plantings and attractive "hardscape" treatments. Selected roundabouts will have sufficient space for buses and trucks to turn around.

Travel Demand

Hillsborough Street carries 26,000 vehicles per day. It is estimated that 30 percent of traffic using Hillsborough Street travels "through", without an origin or destination inside the study area. A suburban four-lane roadway can typically accommodate the traffic on Hillsborough Street, however in the urban setting that characterizes this study area, the capacity of Hillsborough Street is reduced every time:

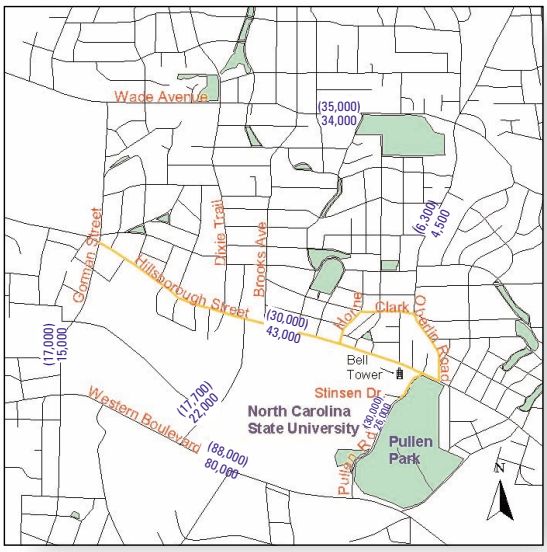
- A vehicle slows down to turn
- A bus blocks a through lane
- A traffic signal changes to give pedestrians time to cross safely

Travel time runs were conducted along the Hillsborough Street corridor to estimate the delay between Gorman Street and Oberlin Road. For the eastbound direction, the seven test runs (four during the morning and three during the afternoon peak-periods) averaged 20.7 miles-per-hour (mph). For the westbound direction, the eight test runs averaged 22.4 mph. However, spot speeds are frequently higher than the posted speed limit of 35 mph, as motorists attempt to make a green light.

With implementation of the planned improvements, it is estimated (using the Triangle Regional Travel Demand Model) that up to 30 percent of traffic will use an alternate route to travel through the area instead of using Hillsborough Street. This will provide space on the street for growth as the area is revitalized with new customers and visitors. The vision that is shared by many is to reinvent and recharge Hillsborough Street as a place for people. The caretakers and stakeholders of Hillsborough Street seek a sense of purpose, place and a much greater mix of activity and excitement. It is to change the way Hillsborough Street is used, from a "through" street to a "destination" street. With the improvements described in this report, it is expected that Western Boulevard will become the primary "through" route in the corridor between West Raleigh and Downtown Raleigh. Only those with a destination, a purpose for stopping, will drive on Hillsborough Street between Gorman Street and Oberlin Road. It is hoped that once someone stops for their primary destination, that they will feel comfortable enough to walk to other places along Hillsborough Street to enjoy a truly remarkable place.

Figure 2 shows estimates of the magnitude of traffic diversion for key roadways in the study area. The estimates are based on the horizon year 2025 and the Triangle Regional Travel Demand Model (January 2001 version using LOS E capacities). As shown in Figure 2, with no changes to Hillsborough Street (referred to as "No Build" in the legend), the daily traffic volume may increase to 43,000 vehicles per day on Hillsborough Street adjacent to the NC State campus. Based on the model, implementation of the planned improvements will divert an estimated 13,000 vehicles per day from Hillsborough Street to alternate routes. The result for Hillsborough Street is a daily volume that approximates the traffic currently carried in that corridor. The implication is that in the mid-term, once improvements are constructed on Hillsborough Street, a portion of the daily traffic will be diverted to other routes. This will "make room" for growth along Hillsborough Street that will naturally come from new buildings on the North Campus of NC State University and revitalization of business activity for merchants that will bring new customers to the area. This dynamic is expected to ensure that the improvements planned for Hillsborough Street will last for many years to come.

Figure 2



Year 2025 ADT Projections "No Build" scenario (Build)

Traffic Volume Redistribution Methodology

Detailed traffic operational analyses for this feasiblity study are based on existing traffic volumes, taken directly from traffic counts performed at thirteen intersections and redistributed based on planned street network changes. Some volume balancing was used along Hillsborough Street after redistribution assumptions were made. Note that the word "intersection" may be used to describe a traditional intersection or roundabout. Through traffic was not redistributed.

- **Dan Allen Drive right-in/right-out reconfiguration (proposed)**
  Left-turning traffic northbound and westbound at the intersection of Hillsborough Street and Dan Allen Drive was redistributed to u-turns between the intersections of Hillsborough Street with Brooks Avenue and Dixie Trail. Northbound left-turns will turn right at the intersection and use the roundabout at Brooks Avenue to return westward. Westbound left turns will proceed past Dan Allen Drive to use the roundabout at Dixie Trail, turning back eastward toward Dan Allen Drive.

- **Brooks Avenue southbound delay**
  Southbound right-turning traffic from Brooks Avenue was redistributed between the current movement and the southbound right-turn at Dixie Trail. The interconnected roadway network provides cross-access between the two parallel roads. As delays increase at Brooks, traffic may re-route to Dixie Trail until equilibrium is reached. Equilibrium is defined in terms of equal delay to motorists approaching Hillsborough Street on southbound Brooks Avenue and southbound Dixie Trail.

- **Gardner Street right-in/right-out (proposed) reconfiguration with closed southern leg**
  Eastbound and southbound left-turning traffic and northbound traffic at the intersection of Hillsborough Street and Gardner Street were redistributed to the intersection of Hillsborough Street and Brooks Avenue. Traffic on the south leg of Gardner Street has been eliminated with construction of the NC State Intermodal Transit Center.

- **Pullen Road extension to Oberlin Road (proposed)**
  Traffic traveling between Pullen Road and Oberlin Road on Hillsborough Street will be redistributed with a majority of the traffic favoring the Pullen extension. The westbound right-turn from westbound Hillsborough Street to Oberlin Road remains a major movement, but most of the traffic previously exiting Oberlin Road at Hillsborough Street will be diverted to the Pullen extension.

Sever through connection on Watauga Club Road. The severed connection of Watauga Club Road to Pullen Road and the right-in/right-out reconfiguration on Hillsborough Street will result in a shift of cut-though traffic and redistribution of traffic. The northbound through and left-turn movements at the intersection of Hillsborough Street and Enterprise Street were redistributed to northbound Pullen Road and returned westbound on Hillsborough Street. The southbound through and left-turn movements at the intersection of Hillsborough Street and Enterprise Street were divided between Horne Street and Oberlin Road/Pullen Extension via Clark Avenue. Eastbound right-turning traffic on Hillsborough Street at Watauga Club Road destined for Pullen Road were assumed to continue through to turn right at Pullen Road. Westbound left-turning traffic on Hillsborough Street at Watauga Club Road will redistribute to turn around the roundabout at the intersection of Hillsborough Street and Pullen Road.

Analysis Methodology

During the course of the study, multiple design alternatives were evaluated for the network as a whole and for individual roundabouts. Synchro 5 is a traffic signal coordination and corridor evaluation software program. Baseline street networks were analyzed for the AM, Mid-Day and PM peak hours with the traffic counts performed for the study. The average travel speed and arterial level of service (LOS) were evaluated for Hillsborough Street using Synchro 5. Levels of Service (LOS) are based on Highway Capacity Manual methodologies.

The program "aaSidra" was used to evaluate the individual roundabouts and recommend design alternatives. It is the accepted and endorsed software program used to evaluate roundabout operations. The LOS associated with the approach delay and the approaching vehicle queue length were used as key performance measures. Queue lengths noted in Table 3 indicate the distance that vehicles are expected to back up while waiting to enter the roundabout during peak hours. Distance is measured from the outer edge of the circulating roadway.

Traffic Operations Analysis Results

A long queue is possible on westbound Hillsborough Street from Brooks Avenue to Dixie Trail during the PM peak hour. The over-capacity conditions for the westbound movement will be minimal if through traffic redistributes to an alternate route. Traffic diversions from Dan Allen Drive to parallel corridors such as Gorman Street would help maintain acceptable levels of service.

A long queue southbound on the Pullen Road Extension can be accommodated with the addition of a second southbound approach lane. The roundabout must accommodate additional traffic due to the planned closure of Watauga Club Road between Pullen Road and Hillsborough Street. Lengthening the dual eastbound lanes to the intersection of Enterprise Street and adding a 150-foot northbound approach bay on Pullen Road will help maintain acceptable levels of service.

It is expected that all remaining queues will be manageable and will not block upstream roundabouts. The results are summarized in Table 3.

Table 3

Base Year Traffic Operations with Planned Improvements
Peak-Hour Capacity Results

Level-of-Service (Delay in Seconds per Vehicle) Queue Length in Feet

Approach	AM	Mid-Day	PM
Hillsborough Street at Gorman/Faircloth Street			
Eastbound Hillsborough St.	A (7) 70'	A (8) 110'	B (130) 280'
Northbound Gorman St.	B (10) 80'	B (11) 80'	C (18) 160'
Westbound Hillsborough St.	A (9) 120'	A (8) 120'	C (16) 350'
Southbound Faircloth St.	B (10) 50'	B (11) 40'	C (16) 100'
Hillsborough Street at Rosemary/Shepherd Street			
Eastbound Hillsborough St.	A (7) 90'	A (7) 110'	A (7) 110'
Northbound Rosemary St.	B (14) 10'	C (15) 10'	C (16) 20'
Westbound Hillsborough St.	A (7) 110'	A (7) 180'	A (8) 310'
Sounthbound Shepherd St.	B (14) 10'	C (20) 10'	D (29) 20'
Hillsborough Street at Dixie Trail/Friendly Drive			
Eastbound Hillsborough St.	C (15) 410'	B (13) 350'	A (10) 230'
Northbound Friendly Dr.	C (19) 10'	D (27) 80'	E (35) 230'
Westbound Hillsborough St.	A (7) 140'	A (7) 240'	D (32) 1500'
Southbound Dixie Trl.	C (20) 110'	D (33) 220'	E (35) 250'
Hillsborough Street at Brooks Avenue			
Eastbound Hillsborough St.	A (7) 120'	A (7) 170'	A (7) 190'
Westbound Hillsborough St.	A (8) 110'	B (15) 510'	C (22) 850'
Southbound Brooks Ave.	B (11) 50'	E (43) 260'	F (140) 510'

Approach	AM	Mid-Day	PM
Hillsborough Street at Horne Street/Lampe Drive			
Eastbound Hillsborough St.	A (8) 90'	A (8) 130'	A (9) 190'
Northbound Lampe Dr.	B (12) 20'	C (16) 30'	C (20) 90'
Westbound Hillsborough St.	A (7) 100'	A (7) 140'	A (8) 200'
Southbound Horne St.	B (14) 60'	C (20) 120'	E (36) 320'
Hillsborough St at Enterprise St/Watauga Club Dr			
Hillsborough Street at Pullen Road			
Eastbound Hillsborough St.	A (9) 80'	B (10) 120'	C (22) 360'
Northbound Pullen Road	A (9) 60'	B (12) 120'	B (15) 180'
Westbound Hillsborough St.	A (9) 100'	B (10) 100'	B (12) 160'
Southbound Pullen Extension	B (12) 90'	B (12) 150'	B (19) 350'
Oberlin Road at Pullen Road Extension			
Eastbound Pullen Extension	A (9) 20'	A (9) 30'	A (9) 40'
Northbound Oberlin Road	A (8) 30'	A (9) 50'	A (10) 50'
Southbound Oberlin Road	A (9) 50'	A (10) 80'	A (10) 120'
Clark Avenue at Horne Street			
Eastbound Clark Avenue	A (8) 40'	A (8) 50'	A (8) 60'
Northbound Horne Street	A (8) 10'	A (8) 20'	A (8) 20'
Westbound Clark Avenue	A (8) 50'	A (8) 60'	A (8) 70'
Southbound Horne Street	A (10) 10'	B (11) 10'	B (12) 10'
Oberlin Road at Clark Avenue			
Eastbound Clark Avenue	A (8) 80'	C (16) 230'	E (43) 700'
Northbound Oberlin Road	A (7) 40'	A (10) 90'	B (11) 130'
Westbound Clark Avenue	A (8) 60'	B (13) 220'	C (21) 380'
Southbound Oberlin Road	A (6) 60'	A (8) 100'	A (10) 140'
Pullen Road at Stinson Drive			
Eastbound Stinson Drive	A (8) 20'	B (11) 30'	B (12) 40'
Northbound Pullen Road	A (8) 90'	A (8) 90'	A (8) 120'
Southbound Pullen Road	A (8) 100'	A (8) 90'	A (9) 170'

Excessive queues affecting adjacent intersections are indicated in bold

Travel Safety

This urban corridor does not function well from a traffic "level of service" perspective, nor does it function at all from a pedestrian, bicycle or transit perspective. In the mid-1990's, the crash rate on Hillsborough Street was four times higher than other four-lane urban roadways in North Carolina. The frequency of crashes involving a pedestrian is unacceptable.

Based on studies published by the Insurance Institute for Highway Safety of conversions of signalized intersections to modern roundabouts, it is estimated that the planned improvements along Hillsborough Street will result in a 70 percent reduction in traffic crashes, as shown in Table 4. The estimated monetary savings in terms of property damage and injuries is nearly $500,000 per year as shown in Table 5.

Table 4

Safety Benefits with Planned Improvements

Hillsborough St. Intersection	Rear End	Left Turn	Side-swipe	Right Angle	Pedestrian	Total
Gorman St/Faircloth St	7	3	9	0	3	22
Rosemary St/Shepherd St	26	7	0	0	1	34
Dixie Trail/Friendly Drive	18	11	6	5	14	54
Dan Allen Drive - Brooks Avenue	4	0	4	1	0	9
Horne Street/Lampe Drive	28	1	2	4	3	38
Enterprise St/Watauga Club Rd.	25	5	0	2	13	45
Pullen Road/Ferndell Lane	8	4	4	2	3	21
Oberlin Road	11	19	1	0	8	39
Total without Improvements	127	50	26	14	45	262
Reduction with Improvements	-76	-40	-21	-11	-40	-188
Percent Improvement	60%	80%	80%	80%	90%	

Table 5

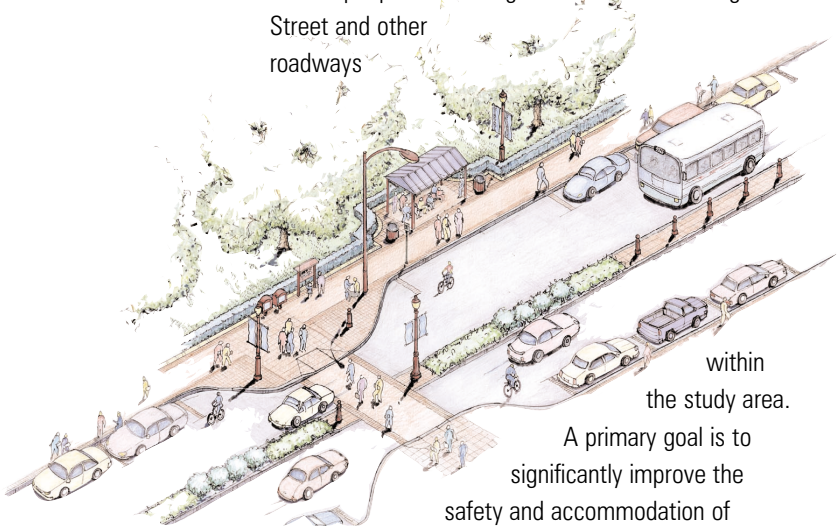
Hillsborough Street is Dangerous

Through July	1996	1997	1998	1999	total
Total number of crashes	231	290	226	132	**897**
Estimated cost ofInsurance claims *(property only)*	$540,000	$680,000	$620,000	$430,000	**$2,270,000**

4.0 RECOMMENDATIONS

There are competing and sometimes conflicting goals for re-use of space Hillsborough Street. Design variations have been evaluated by the Steering Committee to avoid or minimize impacts on various user groups. Consensus has been reached among the Steering Committee that a reasonable balance is reached with the recommended plan. Key study issues are highlighted below.

Pedestrian Safety and Convenience – a lot of people walk along and across Hillsborough Street and other roadways within the study area. A primary goal is to significantly improve the safety and accommodation of pedestrians without causing traffic gridlock. The following design elements are recommended for pedestrian safety and convenience:



Pedestrians are the cornerstone of this plan to rebuild Hillsborough Street.

- Convert Hillsborough Street to two lanes
- Construct seven-foot wide median throughout corridor
- Construct sidewalk bulb-outs at most intersections and some mid-block locations
- Calm traffic to reasonable speeds at intersections by constructing roundabouts
- Discourage pedestrian crossings except at designated crosswalks
- As an interim measure, install countdown pedestrian signals with illuminated push buttons and signal heads
- Restripe pedestrian crosswalks
- Increase the frequency of designated crosswalks. Recommended crosswalk locations are consistent with important pedestrian entrances and paths identified in the Physical Master Plan for NC State University. The following crossing locations are recommended:

Gorman Street
Furches Street
Henderson Street
Stanhope Avenue
Rosemary St/Shepherd St
Concord Street
Daisy Street
McKnight Street
Dixie Trail/Friendly Drive
Bagwell Avenue
Dan Allen Drive
Brooks Avenue
Kilgore Hall
Gardner Street
Pogue Street
2512 Hillsborough Street
Horne Street
Chamberlain Street
Logan Court
Enterprise Street
Pullen Road
Oberlin Road

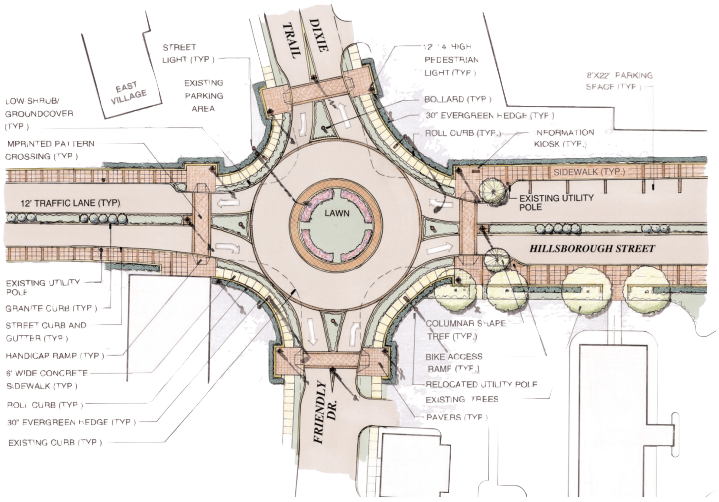
- Pedestrian scale enhancements that are recommended include all of the following: sidewalk and crosswalk pavement detailing, granite curbs, plants, decorative lamposts, benches, kiosks, bus shelters, planter boxes, street directories, and wayfinding signs

Universal Design - originated by NC State University researchers, universal design embraces the philosophy that products and environments be designed so they are useable by all people to the greatest extent possible without the need for adaptation or special features. To assume that people in wheelchairs and people with low vision will readily adapt to roundabouts may not be consistent with the philosophy of universal design. Therefore, the plan includes two intersections that will remain as signalized pedestrian crossings on Hillsborough Street, at Gardner Street and Chamberlain Street.

The signals will be pedestrian-activated and should include audible countdown devices to indicate the remaining time until traffic is stopped and pedestrians

may cross. To avoid overuse, a significant wait time should be programmed (e.g. 60 seconds). As experience is gained in the corridor, further studies and educational programs can be launched to educate pedestrians with special needs in traversing roundabouts. The result of these studies may be the elimination or reduction in the number of signalized pedestrian crossings.

Bicyclists – through trips by bicycle are routed through the corridor now via Clark Avenue, Everett Avenue, Oberlin Road, Park Drive and Hawthorne



Avenue. The recommended plan for Hillsborough Street between Gorman Street and Oberlin Road includes a five-foot wide unmarked "buffer area" between the travel lane and on-street parking stalls. The buffer area is intended to serve multiple purposes, including bicyclists, parallel parking manuevers, buses and space for traffic to pull into when emergency vehicles pass through the corridor.

Bus patrons and drivers – a combination of university (Wolfline), city (CAT) and regional (TTA) bus service generate over 30 buses per hour on eastbound Hillsborough Street with the vast majority generated by Wolfline. Most Wolfline routes use eastbound Hillsborough Street between Dan Allen Drive and Watauga Club Road, running loop routes around campus. Westbound buses on Hillsborough Street are primarily CAT and TTA routes.

In August 2001, NC State opened a new (Wolfline) Intermodal Transit Center, providing a "layover" facility on Founders Drive that will maintain service in the area but significantly reduce the number of Wolfline buses actually on Hillsborough Street between Dan Allen Drive and Horne Street. The number of buses on Hillsborough Street between Horne Street and Watauga Club Road will not change.

In 2008, regional bus service and potentially city bus service will be rerouted when the TTA regional rail station is opened within the interior of the NC State campus, thus reducing the number of buses on Hillsborough Street between Dan Allen Drive and Wataugua Club Road.

The Hillsborough Street Steering Committee discussed the long-term implications of bus service in the corridor. It is recommended that, once the Hillsborough Street improvements are constructed between Brooks Avenue and Horne Street, the Wolfline buses use Hillsborough Street instead of Founders Drive. With the recommended widening of Hillsborough Street in this section, space will be available for layover berths for the Wolfline buses. Founders Drive could be converted to a walkway/bikeway between Dan Allen Drive and Horne Street.

Motorists – Hillsborough Street and environs are designed primarily for the automobile, with multiple travel lanes and in some places an extra lane for left-turning vehicles. Traffic signals are timed to favor traffic, with pedestrians getting minimal time to cross and only after a delay in waiting for the signals to change. Space for pedestrians is crowded, particularly at bus stops and crosswalks.

The plan recommended by the Hillsborough Street Steering Committee strikes a new balance between space for motorists and pedestrians. Currently, 86 percent of the street width is devoted to moving traffic with the remaining 14 percent accommodating parked cars. At midblock crosswalks, the plan would change this to 37 percent for moving traffic, 37 percent for pedestrians, and 26 percent for bicyclists. Elsewhere, the plan would provide 37 percent of the street width for moving traffic, 23 percent for parked cars, 26 percent for bicyclists, and 12 percent for a landscaped median. This new balance will dramatically alter the character and feel of the environment, changing it from a traffic-dominated through-street to a human-scale street with traffic.

Average travel speeds through the corridor will be more uniform, with a high percentage of vehicles traveling in the 20 to 30 mph speed range. The posted speed limit will be 25 mph. The current pattern of stop and go traffic flow will be changed to slow and go, with drivers slowing as they approach roundabouts and mid-block pedestrian crosswalks. While the travel time between Gorman Street and Oberlin Road is expected to increase from the existing average of four minutes, it is anticipated that motorists who are in a hurry will use Western Boulevard or the I-440 Beltline instead.

Each roundabout has been designed to accommodate existing traffic volumes, operating at a reasonable flow rate. Busy intersections have been designed with more than one lane around the roundabout; these are the intersections of Hillsborough Street and Gorman Street, Hillsborough Street and Pullen Road, and Clark Avenue and Oberlin Road. More detailed descriptions of each intersection are documented and illustrated in Section 5.0 of this report.

Parking supply and demand - Parking is key to improving the success of businesses along Hillsborough Street; they cannot survive on pedestrian traffic alone. When completed, the planned improvements along Hillsborough Street will result in a net gain of more than 80 on-street parking spaces, as shown in Table 6.

In 2001 and 2002, the Raleigh City Council and NCDOT will consider approving the following actions to provide additional parking:

- Allow on-street parking on the south side of Hillsborough Street on weekends
- Change parking meters to two hours
- Change posted speed limit on Hillsborough Street to 25 mph
- Study opportunities to increase parking on side streets and alleys
- Encourage the Hillsborough Street Partnership and Hillsborough Street Merchants Association to work with the Downtown Raleigh Alliance to review the approach of parking enforcement issues with the City contract and recommend changes

Furthermore, NC State University will install new signs identifying campus parking lots that are available for "after-hours" public parking.

Emergency Vehicles – Raleigh Fire Station Number Five is located on Oberlin Road inside the study area. Their service area includes the entire study area. Furthermore, police and ambulance service will need

to access addresses up and down the corridor. Accordingly, most roundabouts have been designed to accommodate the larger turning footprint of a fire truck. The outer perimeter of the roundabouts will be designed as a hard surface to accommodate the turns of fire trucks. In the mid-block sections between roundabouts, emergency vehicles will be able to pass as all other traffic will have space to move to the right into the buffer area. The width provided throughout is 17 feet, exclusive of parked cars and the raised curbs (i.e. median and street edge).

Local Delivery Trucks - Further analysis and design resulted in a recommendation for a two-way left-turn lane to serve truck turning movements on the upper section of the hill between Daisy Street and Furches Street, thereby providing space for traffic to pass trucks waiting to turn off of Hillsborough Street.

Table 6
Summary of Parking Impacts

Block	*Existing No. of " public" parking spaces*		*Net Change with "Plan" No. of "public" parking spaces*	
HILLSBOROUGH STREET	**On-Street**	**Off-Street**	**On-Street**	**Off-Street**
1900 block: Oberlin to Ferndell (Darryl's et al.)	0	107 NCSU	+4 on Oberlin	- 60
2000 block: Ferndell to Maiden (Wardlaw Bldg)	3	20 Wardlaw	- 3	-7
2100 block: Maiden to Enterprise (Sadlack's et al.)	4	0	- 4	0 no change
2200 block: Enterprise to Logan (North Hall)	16	160 N. Hall	+3	+100 with new deck
2300 block: Logan to Chamberlain (Bruegger's et al.)	9 Hboro +6 Logan	107 alley +34 NCSU	0	- 6 to connect alley
2400 block: Chamberlain to Horne (former theatre/McDonald's et al.)	9 Hboro +16 Horne	47	+5 Hboro but -10 to make Horne 2-way *(Net –5)*	0 no change
2500 block: Horne to Pogue (Two Guys et al.)	13	0	+13	0 no change
2600 block: Pogue to Gardner (Wachovia et al.)	10	33 Wachovia	+16	- 2 for alley
2700 block: Gardner to Brooks (Papa John's et al.)	0		+35	- 2 for driveway closure
2800 block: Brooks to Dan Allen (Credit Union et al.)	0	0	+16	0 no change
2900 block: Dan Allen to Dixie (Ferguson's et al.)	0		+17	- 4 at Fergusons, - 5 at Subway
3000 block: Dixie to Daisy (Milano's Express et al.)	0		0	-10 w/ s. alley, - 3 with north alley
3100 block: Daisy to Rosemary (Cup a Joe's et al.)	4		- 4*	0 no change
3200 block: Rosemary to Stanhope (Reader's Corner et al.)	0		0	- 2 at Reader's Corner
3300 block: Stanhope to Turner (Servitex et al.)	0		0	0 no change
3400 block: Turner to Gorman (Arby's et al.)	0		0	- 3 at Crown Gas Station
Subtotals	**90**	**508**	**+88 spaces**	**0** *(no net change)*

Notes:

1. *Net change w/ Plan reflects addition or loss if the "Plan" shown on aerial photos in Appendix A is constructed.*
2. *All quantities are the sum of both sides of Hillsborough Street including off-street "public" lots.*
3. *Assumes buses stop next to parked cars except where Wolfline layover is needed (Brooks to Gardner).*
4. *"Public" off-street spaces includes restricted spaces for certain businesses / university that are available to customers during the evenings or on weekends.*
5. *Assumes truck loading zones are relocated off Hillsborough Street to alleys.*
6. *Does not include relocation (i.e. loss) of 100 off-street spaces for NC State Transit Center.*
7. *Median could be no wider than 2 feet to maintain on-street parking at Cup a Joe's.*

Implementation Plan

The roundabouts were designed with input from Michael Wallwork, a nationally renowned expert on roundabouts, Jim Dunlop, a North Carolina-based expert on roundabouts, and using the Roundabout Guidelines (published by the Federal Highway Administration, 2000) for roundabout design. The steering committee provided input during the design process as to the general restrictions and their desired results. Capacity analysis in aaSidra and simulations of alternatives in SimTraffic were used to determine where one-lane roundabouts were not feasible. At the beginning of the study, the intersections of Gorman Street and Pullen Road with Hillsborough Street were designated as two-lane roundabouts for both capacity needs and to serve as transitional gateways for the corridor. A single-lane roundabout was originally proposed at the intersection of Oberlin Road and Clark Avenue, but excessive queues in both aaSidra and SimTraffic showed a need for additional laneage.

The construction of the roundabouts and revised network geometry will be phased in logical stages. Seven major projects are anticipated:

- Project 1: Pullen Road/Stinson
- Project 2: Close Watuga Club Drive, Construct Pullen/Hillsborough roundabout, Pullen extension, and Pullen/Oberlin roundabout
- Project 3: Hillsborough at Rosemary/Shepar
- Project 4: Hillsborough between Brooks and
- Project 5: Hillsborough between Brooks and Enterprise with Clark/Horne roundabout
- Project 6: Clark/Oberlin roundabout
- Project 7: Hillsborough between Shepard ar Gorman with roundabout at Gorman

Due to the relatively low volume and current unsignalized geometry, the intersection of Pullen Road at Stinson Drive (Project 1) is the most feasible location for initial construction and testing of a roundabout in the area. Detailed design may also begin for all roundabouts and geometric changes proposed along the corridor. Corridor engineering surveys must be conducted in order to begin detailed design.

The opinion of probable cost for each project is listed in Table 7. The total for all seven projects in the study area is $16 million. An additional $8 million is identified for utility relocation and burial.

Each project will require additional design work to reconcile the concept plans shown in Section 5.0 of this report with a ground survey and detailed investigation of utilities. Early in the design phase, further efforts to involve property owners and interested citizens should be made by the design team and Hillsborough Street Partnership.

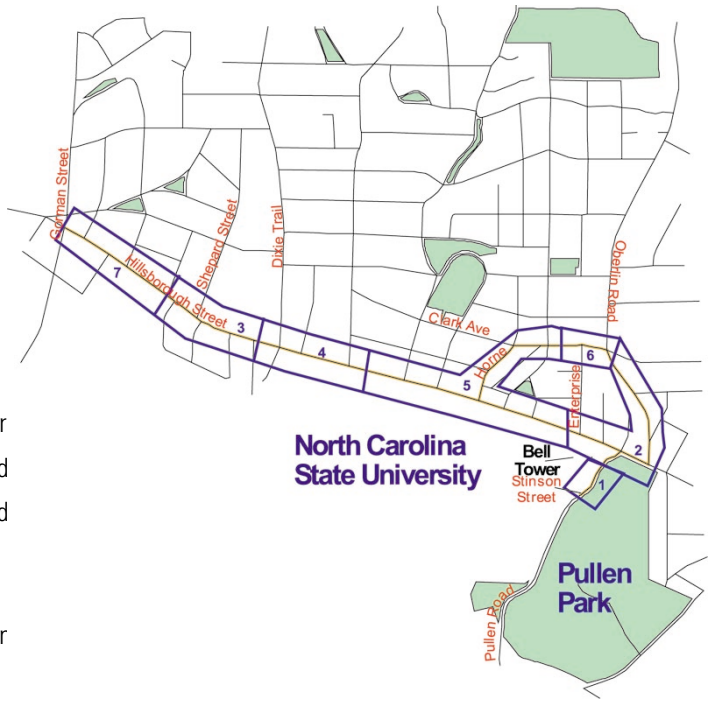


Table 7
Planning Level Estimate*

Location	Base Cost Estimate	Additional Cost Relocate Utility Lines
Project 1		
Pullen/Stinson Total	$ 360,000	0
Project 2		
Pullen between Stinson & Hillsborough	$ 170,000	
Pullen/Hillsborough roundabout	$1,000,000	
Pullen between Hillsborough & Oberlin	$ 900,000	
Pullen/Oberlin roundabout	$ 550,000	
Oberlin between Pullen & Hillsborough	$ 10,000	
Hillsborough between Oberlin & Enterprise	$ 170,000	
Project 2 Total	*$2,800,000*	*$1,000,000*
Project 3		
Hillsborough between Dixie & Rosemary	$1,600,000	
Hillsborough/Rosemary/Shepherd	$ 850,000	
Hillsborough between Rosemary & Furches	$ 850,000	
Project 3 Total	*$3,300,000*	*$1,000,000*
Project 4		
Hillsborough/Brooks roundabout	$ 800,000	$ 175,000
Hillsborough between Brooks & Dixie	$ 700,000	$1,200,000
Hillsborough/Dixie roundabout	$1,300,000	$ 175,000
Project 4 Total	*$2,800,000*	*$1,550,000*
Project 5		
Hillsborough/Enterprise left-turn restrictions	$ 150,000	$ 110,000
Hillsborough between Enterprise & Horne *(with alleys)*	$1,000,000	$ 800,000
Hillsborough/Logan roundabout	$ 600,000	$ 250,000
Hillsborough/Horne roundabout	$ 800,000	$ 200,000
Hillsborough between Horne & Brooks	$1,400,000	$1,100,000
Clark between Oberlin & Horne	$ 400,000	$ 750,000
Clark/Horne roundabout	$ 550,000	$ 100,000
Project 5 Total	*$5,000,000*	*$3,400,000*
Project 6		
Clark/Oberlin roundabout	$ 650,000	$ 400,000
Project 7		
Hillsborough between Furches & Gorman	$ 90,000	$ 620,000
Hillsborough/Gorman roundabout	$1,000,000	$ 120,000
Project 7 Total	*$1,190,000*	*$ 740,000*
Grand Total	**$16,000,000**	**$8,000,000**

**Does not include any pavement rehabilitation cost.*

BEFORE/AFTER IMAGES

At Horne Street/Hillsborough Street

BEFORE/AFTER IMAGES

At Dixie Trail/Hillsborough Street

BEFORE/AFTER IMAGES

At Bell Tower